Massachusetts Department of Environmental Protection (MassDEP)
Top Case Best Available Control Technology (BACT) Guidelines
For
COMBUSTION SOURCES

This information is maintained by the MassDEP, Bureau of Waste Prevention, Air Quality Permitting Section, and is subject to change. These requirements represent Top Case BACT guidelines for Major and Non-major air contaminants emitting sources, and are published for informational purposes only, to enhance program transparency and facilitate MassDEP's goal of "permitting at the speed of business". Use of the applicable Top Case BACT emissions limitations contained herein may preclude the need for applicants to prepare and submit a "top-down BACT analysis" for MassDEP's review, and will streamline the Air Quality permitting process for both the applicants and MassDEP. Applicants should note that BACT requirements for any new or modified air contaminants source are subject to change through the MassDEP 310 CMR 7.02 Air Quality Plan Approval (permitting) procedures. Please contact the MassDEP Regional Office that regulates your facility should you have any questions related to these Top Case BACT guidelines.

Please be aware that, in addition to BACT requirements, federal NSPS, MACT and/or GACT requirements may also apply pursuant to 40 CFR Parts 60, 61 and 63.

Page

BOILERS (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**Control Technology**	**BACT Determination**
Boilers 10 mmBtu to <40 MMBtu	Natural Gas	NOx	0.0350 lb/MM Btu	• Low NOx burners, FGR	310 CMR 7.26(33)(b): IPS Regulations
		PM	0.010 lb/MM Btu		
		CO	0.080 lb/MM Btu		
		VOC	0.030 lb/MM Btu		
Boilers 10 mmBtu to <40 MMBtu	Ultra Low Sulfur Distillate 0.0015 %	NOx	0.150lb/MMBtu	• Low NOx burners, FGR	310 CMR 7.26(33)(b): IPS Regulations
		PM	0.020 lb/MMBtu		
		CO	0.080 lb/MM Btu		
		VOC	0.030 lb/MM Btu		
Boilers ≥40 MMBtu to <100 MMBtu	Natural Gas	NOx	0.011 lb/MMBtu	• Ultra Low NOx burners, Low NOx burners, FGR	US EPA RBLC Database
		PM	0.002 lb/MMBtu		
		CO	0.035 lb/MMBtu		
		VOC	0.035 lb/MMBtu		
Boilers ≥40 MMBtu to <100 MMBtu	Ultra Low Sulfur Distillate 0.0015 %	NOx	0.100 lb/MMBtu	• Ultra Low NOx burners, Low NOx burners, FGR	US EPA RBLC Database
		PM	0.015 lb/MMBtu		
		CO	0.035 lb/MMBtu		
		VOC	0.035 lb/MMBtu		
Boilers ≥100 mmBtu to <250 MMBtu	Natural Gas	NOx	0.011 lb/MMBtu	• Ultra Low NOx burners, Low NOx burners, FGR, SCR	310 CMR 7.02 Plan Approval, Transmittal Number X229675
		PM	0.01 lb/MMBtu		
		CO	0.011 lb/MMBtu		
		VOC	0.03 lb/MMBtu		

BOILERS (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**Control Technology**	**BACT Determination**
Boilers >100 MMBtu to 249 MMBtu	Ultra Low Sulfur Distillate 0.0015 %	NOx	0.100 lb/MMBtu	• Ultra Low NOx burners, Low NOx burners, FGR, SCR	310 CMR 7.02 Plan Approval, Transmittal Number X229675
		PM	0.03 lb/MMBtu		
		CO	0.035 lb/MMBtu		
		VOC	0.03 lb/MMBtu		
Boilers ≥250 MMBtu	Natural Gas	NOx	0.011 lb/MMBtu	• Ultra Low NOx burners, Low NOx burners, FGR, SCR	US EPA RBLC Database
		PM	0.002 lb/MMBtu		
		CO	0.015 lb/MMBtu		
		VOC	0.015 lb/MMBtu		
Boilers ≥250 MMBtu	Ultra Low Sulfur Distillate 0.0015 %	NOx	0.100 lb/MMBtu	• Ultra Low NOx burners, Low NOx burners, FGR, SCR	US EPA RBLC Database
		PM	0.015 lb/MMBtu		
		CO	0.035 lb/MMBtu		
		VOC	0.035 lb/MMBtu		
Boilers ≥250 MMBtu	Coal	NOx	0.030 lb/MMBtu	• Low NOx burners, FGR • SCR • Oxidization catalyst • FF/Baghouse • FGD (wet or dry at 98-99 % removal efficiency)	US EPA EIA Database
		PM	0.0100 lb/MMBtu		
		CO	0.050 lb/MMBtu		
		VOC	0.035 lb/MMBtu		
		SO_2	0.080 lb/MMBtu		
		NH_3	2 ppmvd at 3% O_2		

Key to Abbreviations

lb/MMBtu = pounds per million British thermal units
ppmvd = parts per million volume dry
% = weight percent
NOx = nitrogen oxides
SO_2 = sulfur dioxide
PM = particulate matter (including condensables)
O_2 = oxygen
CO = carbon monoxide
NH_3 = ammonia
VOC = volatile organic compounds
FF = fabric filter/baghouse
SCR = selective catalytic reduction technology
CEMS = continuous emissions monitoring system
FGD = flue gas desulfurization
FGR = flue gas recirculation
RBLC = RACT BACT LAER Clearinghouse

INCINERATORS (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations***	**Control Technology**	**BACT Determination**
Municipal Waste	Municipal solid waste (household, commercial, and institutional waste)	NOx	2 ppmvd	• Gasification of MSW to SynGas • Combustion of SynGas via Combustion Turbine Technology (or equivalent combustion methodology). • Pollutant emissions may be controlled during syngas production and/or post-combustion.	• LA County Conversion Technology Evaluation Report – Phase II – Assessment (October 2007) • NYC Focused Verification and Validation of Advanced SW Management Conversion Technologies – Phase 2 Study (March 2007)
		NH_3	2 ppmvd		
		CO	2 ppmvd		
		VOC	2 ppmvd		
		Cd	**		
		Pb	**		
		Hg	**		
		SO_2**	**		
		HCl**	**		
		Dioxin/Furan (CDD/CDF)	**		
Medical Waste (for all incinerator sizes)	Medical and pathological waste	NOx	250 ppmvd	• dry scrubber, wet scrubber • good combustion control Practices • carbon injection	US EPA 40 CFR Part 60 Subpart Ec
		PM	0.015 gr/dscf		
		CO	40 ppmvd		
		SO_2	55 ppmvd		
		Pb	0.07 mg/dscm or 98% removal efficiency		
		Cd	0.04 mg/dscm or 90% removal efficiency		
		Hg	0.55 mg/dscm or 85%		

INCINERATORS (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations***	**Control Technology**	**BACT Determination**
			removal efficiency		
		Dioxin/Furan Total	25 ng/dscm		
		Dioxin/Furan TEQ	0.6 ng/dscm		
Crematoria (Human bodies and body parts)	Natural Gas	PM	0.06 gr/dscf	• Secondary chamber design retention time and temperature, 1 second at 1,800 degrees °F • Secondary chamber minimum operating temperature, 1,600 °F • Opacity Monitor	310 CMR 7.02 Plan Approval, Transmittal Number X227136
		CO	100 ppmvd		
		Opacity	10 percent		

*all emission limitations are corrected to 7 percent O_2

**Emissions of metals (Cd, Hg, Pb, etc.), dioxin/furans (CDD/CDF) and acid gases (HCl and H_2SO_4/SO_2) are to be determined on a case-by-case basis, consistent with the MassDEP BACT Guidelines, NESCAUM BACT Guidelines, and US EPA NSR BACT requirements. Ambient air quality modeling will be required to demonstrate compliance with MassDEP "Ambient Air Exposure Limits for Chemicals in Massachusetts".

Key to Abbreviations

mg = milligram
ng = nanogram
gr = grains
dscf = dry standard cubic foot
dscm = dry standard cubic meter
ppmvd = part per million volume dry
% = weight percent
NOx = nitrogen oxides
SO_2 = sulfur dioxide
PM = particulate matter (including condensables)
O_2 = oxygen
Pb = lead
Cd = cadmium
Hg = mercury
CO = carbon monoxide
HCl = hydrogen chloride
FF = fabric filter
ESP = electrostatic precipitator
SNCR = selective non catalytic reduction
CEMS = continuous emissions monitoring system
FGD = flue gas desulfurization
TEQ = toxic equivalent

BIOMASS FUEL FIRED STEAM ELECTRIC GENERATION UNITS (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**Control Technology**	**BACT Determination**
EGUs ≥ 25 MW	Biomass	NOx	0.015 lbs/MMBtu	• SCR • Oxidization Catalyst • FF/Baghouse • AERSRCEEN or AERMOD for Toxics Modeling • Metals testing for C&D and possibly other biomass • PM testing must also included condensable PM • FGD	MassDEP BACT Guidance for Biomass Projects, April 2007
		PM	0.012 lbs/MMBtu		
		CO	0.01 lbs/MMBtu		
		VOC	0.01 lbs/MMBtu		
		SO_2	0.02 lbs/MMBtu		
		NH_3	2 ppmvd at 3 percent O_2		
		Opacity	5 percent		
		HCl	20 ppmvd at 3 percent O_2		
		Toxics*	• 85% Hg RE • 99% Heavy Metal RE • AALs and TELs compliance modeling demonstration		
EGUs Equal to or > 10 MW and < 25 MW	Biomass	NOx	0.015 lbs/MMBtu	• SCR • Oxidization Catalyst • FF/Baghouse • AERMOD for Toxics Modeling • Metals testing for C&D and possibly other	MassDEP BACT Guidance for Biomass Projects, April 2007
		PM	0.012 lbs/MMBtu		
		CO	0.01 lbs/MMBtu		
		VOC	0.01 lbs/MMBtu		
		SO_2	0.02 lbs/MMBtu		
		NH_3	2 ppmvd at 3 percent O_2		
		Opacity	5 percent		

BIOMASS FUEL FIRED STEAM ELECTRIC GENERATION UNITS (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**Control Technology**	**BACT Determination**
		HCl	20 ppmvd at 3 percent O_2	biomass • PM testing must also included condensable PM • FGD	
		Toxics*	• 85% Hg RE • 99% Heavy Metal RE • AALs and TELs compliance modeling demonstration		
EGUs Equal to or > 1 MW and < 10 MW	Biomass	NOx	0.093 lbs/MMBtu	• SCR • Oxidization Catalyst • FF/Baghouse • AERMOD for Toxics Modeling • Metals testing for C&D and possibly other	MassDEP BACT Guidance for Biomass Projects, April 2007
		PM	0.012 lbs/MMBtu		
		CO	0.25 lbs/MMBtu		
		VOC	0.01 lbs/MMBtu		
		SO_2	0.02 lbs/MMBtu		
		NH_3	10 ppmvd at 3 percent O_2		
		Opacity	5 percent		
		HCl	20 ppmvd at 3 percent O_2		

BIOMASS FUEL FIRED STEAM ELECTRIC GENERATION UNITS (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**Control Technology**	**BACT Determination**
		Toxics*****	• 85% Hg RE • 99% Heavy Metal RE • AALs and TELs compliance modeling demonstration	biomass • PM testing must also included condensable PM • FGD	

*****Ambient air quality modeling will be required to demonstrate compliance with MassDEP "Ambient Air Exposure Limits for Chemicals in Massachusetts". for projects where: 1. construction and demolition wood is burned; 2. boilers that are major source of Criteria Air Contaminants or Hazardous Air Pollutants.

Key to Abbreviations

lb/MMBtu = pounds per million British thermal units
% = weight percent
ppmvd = parts per million volume dry
NOx = nitrogen oxides
SO_2 = sulfur dioxide
PM = particulate matter (including condensables)
O_2 = oxygen
CO = carbon monoxide
NH_3 = ammonia
HCl = hydrogen chloride
FF = fabric filter/baghouse
RE = removal efficiency

SCR = selective catalytic reduction technology
CEMS = continuous emissions monitoring system
FGD = flue gas desulfurization
AAL = Allowable Ambient Limit
TEL = Threshold Effects Exposure Limit

RECIPROCATING INTERNAL COMBUSTION ENGINES (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**		**BACT Determination**
IC Engines equal to or > 50 kW (On or after 1/1/08)	Natural Gas	NOx	0.3 lbs/MW-hr		310 CMR 7.26(43)(b): Table 2 and 4 IPS Regulations
		CO	2 lbs/MW- hr		
		CO_2	1900 lbs/MW-hr		
IC Engines equal to or > 50 kW (On or after 1/1/08)	Ultra Low Sulfur Distillate 0.0015 %	NOx	0.3 lbs/MW-hr		310 CMR 7.26(43)(b): Table 2 and 4 IPS Regulations
		PM	0.07 lbs/MW-hr		
		CO	2 lbs/MW- hr		
		CO_2	1900 lbs/MW-hr		
IC Engines equal to or > 50 kW (On or after 1/1/12)	Natural Gas	NOx	0.15 lb/MW-hr		310 CMR 7.26(43)(b): Table 2 and 4 IPS Regulations
		PM	0.03 lb/MW-hr		
		CO	1 lb/MW-hr		
		CO_2	1650 lb/MW-hr		
IC Engines equal to or > 50 kW (On or after 1/1/12)	Ultra Low Sulfur Distillate 0.0015 %	NOx	0.15 lb/MW-hr		310 CMR 7.26(43)(b): Table 2 and 4 IPS Regulations
		PM	0.03 lb/MW-hr		
		CO	1 lb/MW-hr		
		CO_2	1650 lb/MW-hr		
IC Engines equal to or > 37 kW (Emergency Engines)	Natural Gas or Ultra Low Sulfur Distillate 0.0015 %	Must comply with the applicable emission limitations set by US EPA for non-road engines at 40 CFR 89.			310 CMR 7.26(42)(b)1. IPS Regulations

Key to Abbreviations:

lbs/MW-hr = pounds per megawatt hour
NOx = nitrogen oxides
PM = particulate matter (including condensables)
CO = carbon monoxide
CO_2 = carbon dioxide
MW = megawatt
kW = kilowatt
% = weight percent
IPS = Industrial Performance Standards

COMBUSTION TURBINES (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**BACT Determination**	**Control Technology**
Combined Cycle Turbine > 10 MW/hr	Natural Gas	NOx	2.0 ppmvd at 15 % O_2	Plan Approval, Transmittal Number W004632	• Dry Low NOx Combustor • SCR • Oxidation catalyst • NOx, CO, NH_3 CEMS
		NH_3	2.0 ppmvd at 15 % O_2		
		CO	2.0 ppmvd at 15 % O_2		
		VOC	1.7 ppmvd at 15 % O_2		
		CO_2	Contact Regional Office		
Combined Cycle Turbine > 10 MW/hr	Ultra Low Sulfur Distillate Oil 0.0015 %	NOx	6.0 ppmvd at 15 % O_2	Plan Approval, Transmittal Number W004896	• Dry Low NOx Combustor • SCR • Oxidation catalyst • NOx, CO, NH_3 CEMS
		NH_3	2.0ppmvd at 15 % O_2		
		CO	7.0 ppmvd at 15 % O_2		
		VOC	7.0 ppmvd at 15 % O_2		
		CO_2	Contact Regional Office		
Simple Cycle Turbine > 10 MW/hr	Natural Gas	NOx	2.5 ppmvd @15 % O_2	Plan Approval, Transmittal Number W120701	• Dry Low NOx Combustor • SCR • Oxidation catalyst • NOx, CO, NH_3 CEMS
		NH_3	5.0 ppmvd @ 15 % O_2 with an optimization program to achieve 2.0 ppmvd @15 % O_2		
		CO	5.0 ppmvd @15 % O_2		
		VOC	2.5 ppmvd @15 % O_2		
		CO_2	Contact Regional Office		
Simple Cycle Turbine	Ultra Low Sulfur Distillate	NOx	5.0 ppmvd at 15 % O_2	Plan Approval, Transmittal Number W120701	• Dry Low NOx

COMBUSTION TURBINES (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**BACT Determination**	**Control Technology**
> 10 MW/hr	Oil 0.0015 %	NH_3	5.0 ppmvd at 15 % O_2		Combustor • SCR • Oxidation catalyst • NOx, CO, NH3 CEMS
		CO	5.0 ppmvd @15 % O_2		
		VOC	4.5 ppmvd @15 % O_2		
		CO_2	Contact Regional Office		
Combustion Turbine Less than 1 MW	Natural Gas	NOx	0.47 lbs/MW-hr	310 CMR 7.26(43) IRP Regulation	
		CO	0.47 lbs/MW-hr		
		CO_2	NA		
Combustion Turbine 37 kW to ≤1 MW (Emergency Only)	Ultra Low Sulfur Distillate Oil 0.0015 %	NOx	0.60 lbs/MW-hr	310 CMR 7.26(42) IRP Regulation	
		CO_2	Contact Regional Office		
Combustion Turbine 1 MW to 10 MW	Natural Gas	NOx	0.14 lbs/MW-hr	310 CMR 7.26(43) IRP Regulation	• SCR • Oxidation catalyst • (possible required technology)
		NH_3	2.0 ppmvd @ 15 % O_2		
		CO	0.09 lbs/MW-hr		
		CO_2	1900 lbs/MW-hr		
Combustion Turbine 1 MW to 10 MW	Ultra Low Sulfur Distillate Oil 0.0015 %	NOx	0.34 lbs/MW-hr	310 CMR 7.26(43) IRP Regulation	• SCR • Oxidation catalyst • (possible required technology)
		NH_3	2.0 ppmvd @ 15 % O2		
		CO	0.18 lbs/MW-hr		
		CO_2	1900 lbs/MW-hr		
Combined Cycle Combustion Turbine Coal Gasification	Coal	NOx	2.0 ppmvd at 15 % O_2	See Combined Cycle Turbine Transmittal Numbers above	• Gasification of coal with gas cleaning technology • Post-combustion GT
		NH_3	2.0 ppmvd at 15 % O_2		
		CO	2.0 ppmvd at 15 % O_2		

COMBUSTION TURBINES (June, 2011)					
Source Type	**Fuel**	**Air Contaminant**	**Emission Limitations**	**BACT Determination**	**Control Technology**
IGCC Technology		VOC	2.0 ppmvd at 15 % O_2		gas cleaning
		CO_2	Contact Regional Office		

Key to Abbreviations:

lbs/MW-hr = pounds per megawatt hour
lb/MMBtu = pounds per million British thermal unit
ppmvd = part per million volume dry
NOx = nitrogen oxides
CO = carbon monoxide
CO_2 = carbon dioxide
O_2 = oxygen
VOC = volatile organic compounds
NOx = nitrogen oxides
NH_3 = ammonia
MW = megawatt
SCR = selective catalytic reduction
CEMS = continuous emissions monitoring system
% = weight percent
GT = gas turbine
kW = kilowatt
IGCC = integrated gasification combined cycle

*Emission Limitations – Output Based shall incorporate the heat rate component necessary to evaluate energy efficiency. At this time BWP should evaluate only the specific combustion unit or system (simple cycle turbine, combined cycle turbine, etc.), however BWP should request the project proponent to evaluate the proposed project as a "whole" and provide a facility output based emission rate (BACT) for the project to incorporate the use of energy efficient of ancillary equipment.